Why are we concerned about Indoor Air

- Many contaminants higher indoor and strongly influence exposures
- Construction techniques, materials and consumer products continually change
- Health, comfort and productivity are effected by indoor environmental conditions

Modern Construction

Fiberglass Ducts

Asbestos Insulation
Asbestos in the Lungs

Synthetic Materials

Blocked Ceiling Plenums

Moldy Ceiling Tiles

Office Machines

IAQ of the 1980's

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RADON</td>
<td>HCHO</td>
</tr>
<tr>
<td>ETS</td>
<td>VOC’S</td>
</tr>
<tr>
<td>ASBESTOS</td>
<td>NO.</td>
</tr>
</tbody>
</table>
**Nitrogen Dioxide and Carbon Monoxide**

- 40% US homes have gas
- Back drafting happens
- Efficient furnaces need booster fans
- CO sub-acute exposure a problem
- NOx and allergens

**NO2 a Concern in Public Housing**

Increase frequency of resp. syms. among infants at risk for asthma with NO2. van Stein 2005

NO2 and allergens increase asthma symps. in chamber studies. Bach 2002, Strand 1997, Tunnelliefe 1994

NO2 a week prior to resp. viral infection associated with increase in Sym severity of a resulting asthma exacerbation. Chauhan 2003

**Glamour of Cigarettes**

**Maternal Smoking and LRI**

**Lung Cancer Risk**

**Radon**
**Radon Risks**

- EPA Guideline 4pCi/l
- 20 times outdoor levels
- 4 times lung cancer risk of non-smoker
- 60 lung cancers per 1,000 among smokers
- 7 lung cancers per 1K non-smokers

20,000 lung cancers per year

**Carcinogenic Risk Assessment of Volatile Organic Compounds and Metals of Teenagers in New York City and Los Angeles**

- ODORS TRIGGER MEMORIES
- EMOTIONS
- ANXIETIES
- TRANQUILITY

**EPA Modeled Ambient Risks**

- New York
  - 1.2x10^-4
  - Personal: 15%
  - Indoors: 8%
  - Outdoors: 21%
- Los Angeles
  - 5.2x10^-4
  - Personal: 6%
  - Indoors: 7%
  - Outdoors: 40%

**TEACH Ambient Risks**

- New York
  - 4.4x10^-4
  - Personal: 15%
  - Indoors: 8%
  - Outdoors: 60%
- Los Angeles
  - 2.4x10^-4
  - Personal: 6%
  - Indoors: 7%
  - Outdoors: 40%
IAQ of the 1990’s

<table>
<thead>
<tr>
<th>SBS</th>
<th>MOLDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PESTICIDES</td>
<td>ALLERGENS</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>LATEX</td>
</tr>
</tbody>
</table>

What is “mold”?

- **Plants:** make food from air, water, and sunlight
- **Animals:** ingest (eat) food and digest and absorb it internally
- **Fungi:** digest food externally by releasing digestive enzymes into the environment

Why be concerned about molds?

- LIABILITY
- RELIABILITY
- DURABILITY
- RESPONSIBILITY

MOLDS THAT HELP US

- **Penicillium**

Media Exploitation

- “The Toxic Mold Avenger”
- ‘Welcome to Moldywood’
Passamaquady Homes

Moisture behind siding was the problem with Tri-State Homes

Health effects of exposure to mold

- Allergies and asthma
- Infections
- Irritation
- Other effects

> 30% of Americans Have Allergies

17 Million Americans Have Asthma
Asthma Up 75% [1980-1994]

Dampness in buildings and health effects--NORDAMP

- Scientific review of all the epidemiological studies (590)
- 61 articles from US, Canada, Europe provided useful information
- 9 scientist reviewers

**DAMPNESS increases relative risk OR 1.4—2.2**

- Cough, wheeze, asthma, tiredness, headache, airway infection

**Health effects: Irritation**

- Moldy odors are produced by gases released during mold growth
- Odors are annoying, and the gases may cause eye, nose and throat irritation
- Glucans (cell wall components) may be irritating in VERY high concentrations

**Irritation**

**Mycotoxins**

- Aspergillus flavus
- A. vericolor
- Fusarium
- Stachybotrys
- Metabolites to defend food sources against vertebrates

**Stachybotrys chartarum**

- TRICOTHECENES irritate skin mucosa, inhibit protein, RNA, DNA synthesis, immunosuppressive
What do molds need for growth?

- Water
- Nutrients
- Warmth
- Other factors

- Water must be continuously present
- Amount of water needed depends on:
  - the kind of mold
  - the kind of material used as food
  - temperature

What do molds need for growth?

- Paper
  - wallpaper, wallboard, ceiling tiles
- Sugars
  - Fruits, vegetables, pastes, glues
- Fabrics
- Dust (skin scales)
- Wood

Sources and amplification sites

- Outdoor air
- Carpets
- Furniture
- Humidifiers
- HVAC
- Wallboard, wood, insulation

Wood Rot

HUMIDIFIER

- EASILY CONTAMINATED
- RARELY INSPECTED OR CLEANED
Preventing Mold Problems

- DESIGN—insulation, thermal bridges, ventilation, air conditioning system, surfacing materials
- CONSTRUCTION—dry materials, flashing, caulking, insulation, landscape
- OCCUPANCY—furnishings, cleaning, ventilation, moisture control

IAQ of the 2000’s

<table>
<thead>
<tr>
<th>PHTHALATES</th>
<th>METALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERSISTENT</td>
<td>ENDOTOXINS</td>
</tr>
<tr>
<td>POLLUTANTS OP PBDE,PCB’s</td>
<td>MYCOTOXINS and ACTINOMYCETES</td>
</tr>
<tr>
<td>CHEMICAL SENSITIZERS</td>
<td>INFECTIONS C/BW</td>
</tr>
</tbody>
</table>

Synthetic Organic Compounds in Indoor Air and Dust*

- Excess Breast Cancer on Cape Cod, MA
- Historical use of pesticides on cranberry bogs, golf courses and mosquito control
- Potential endocrine disruption compounds exposure in homes

* Rudel et al 2003 Household Exposure to Phthalates, Alkylphenols, Pesticides, PBDEs, and Other Endocrine Disruptors in Indoor Air and Dust

Motivation

- USEPA reports 3000 chemicals produced or imported in USA per year with >1M pounds/yr
- 43% No testing for basic toxicity
- 7% Complete basic toxicity testing but not for endocrine activity

Bisphenol A & Phthalates ~ 1B pounds/yr

www.epa.gov/opptintr/chemtest/hazchem.htm 1999

Chemicals in Commerce

- Plastics
- Disinfectants
- Flame retardants
- Pest control
- Adhesives
- Detergents
- Cleaners
- Emulsifiers
- Latex paints

Study Overview (n=120 homes)

<table>
<thead>
<tr>
<th>Chemical Group</th>
<th>Dust</th>
<th>Air</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides</td>
<td>38</td>
<td>39</td>
<td>13</td>
</tr>
<tr>
<td>Alkylphenols</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Phthalates</td>
<td>10</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>PCBs, PAHs, PBDEs</td>
<td>10</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Parabens</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Other estrogenic phenols</td>
<td>18</td>
<td>20</td>
<td>-</td>
</tr>
</tbody>
</table>
Might-mite vacuum with PTFE Teflon extraction thimble. Surfaces of 4-5 rooms for 4gms.

**Results: compounds found per house**

<table>
<thead>
<tr>
<th></th>
<th>DETECTED</th>
<th>AVE</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR</td>
<td>52 of 88</td>
<td>20.7</td>
<td>14 - 32</td>
</tr>
<tr>
<td>DUST</td>
<td>66 of 86</td>
<td>27.6</td>
<td>4 - 46</td>
</tr>
</tbody>
</table>

**Most Abundant Compounds**

- Phthalates -------- plasticizers, emulsifiers
- O-phenylphenol ----- disinfectants
- 4-nonylphenol ------ detergent metabolite
- 4-t-butylphenol ---- adhesive
- PBDE              ----- flame retardants
- Pesticides        ----- 23 in air & 27 in dust

**PBDE Flame Retardants**

- Polybrominated diphenyl esters
- Persistent
- Bioaccumulates
- Breast milk concentrations approaching toxic levels in Canadian women

**PBDE rising in breast milk in North America**


- PBDE flame retardants in foams and plastics
  - Acts as EDC via thyroid hormone
    - (Zhou 2001, 2002)
  - Detected 2,3 dibromo-1-propanol intermediate in TRIS banned in 1977
  - Bioaccumulate

**Bioaccumulation: an Arctic aquatic food chain**

Seawater (1x)

Phytoplankton (~10x)

Fish (~100x)

Seal (~1,000x)

Polar bear (~10,000x)

(Photos: Anna Roos, Swedish Museum of Natural History)


(Photos: Qarin Van Brink, 1998)
Phthalates in Dust

Concentration (micrograms/g dust)

Cumulative Frequency

0.0 0.2 0.4 0.6 0.8 1.0

bis(2-ethylhexyl) phthalate
benzyl butyl phthalate
di-n-butyl phthalate
diethyl phthalate
bis(2-ethylhexyl) adipate (2,3)
di-isobutyl phthalate
dicyclohexyl phthalate
di-isononyl phthalate

DEHP  BBzP

The Association Between Asthma and Allergic Symptoms in Children and Phthalates in House Dust. A Nested Case-control study

Carl-Gustaf Bornehag, Jan Sundell, Charles Weschler, Torben Sigsgaard, Eijiro Lundgren, Mikael Hasselgren, Linda Hägerhed-Engman

Swedish National Testing and Research Institute
Technical University of Denmark
Karlstad University, Sweden
Aarhus University, Denmark
UMDNJ-RW Johnson Medical School and Rutgers University, USA

Dust samples from 390 homes

- Dust was collected above floor level on a filter in children’s bedroom
- 346 valid samples (Dust samples >25 mg)
- Six phthalates identified
  - DEP
  - DIBP
  - DnBP
  - BBzP
  - DEHP
  - DINP

Phthalates conc. Vs. C-C status

<table>
<thead>
<tr>
<th>BBzP (Log mg/g dust)</th>
<th>Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.6</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>-0.7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>-0.8</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>-0.9</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>-1.0</td>
<td>13</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEHP (Log mg/g dust)</th>
<th>Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>-0.1</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>-0.2</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>-0.3</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>-0.4</td>
<td>18</td>
<td>9</td>
</tr>
</tbody>
</table>

Adj OR for symptoms

<table>
<thead>
<tr>
<th>Adj OR</th>
<th>Asthma</th>
<th>Rhinitis</th>
<th>Eczema</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Qtr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Qtr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd Qtr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th Qtr</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Adj OR for ASTHMA & % Asthma for DEHP**

- Depicted in a bar graph showing the adjusted odds ratio (Adj OR) for asthma in different quartiles of DEHP exposure.

**CDC’s Body Burden Study**

- 3,800 persons from 12 U.S. locations
- Blood and urine samples
- 27 potentially toxic compounds
- Pb, Cd, cotinine had trends data

From: National Report on Human Exposures to Environmental Chemicals, CDC, 3/21/01

**CDC’s Body Burden Study**

- 12 metals including Co, Hg, U
- 6 organophosphate pesticide metabolites
- 7 phthalate metabolites – fragrances, hand lotions, industrial solvents, flexible plastic products

From: National Report on Human Exposures to Environmental Chemicals, CDC, 3/21/01

**FDA and EPA will address Cosmetics**

- $35 billion a year
- Cosmetic, Toiletry and Fragrance Association represents 600 manufacturers
- EU banned substances in Sept. that show cancer in animals, DNA damage or reproductive problems

**“Cosmetic safety is in doubt”**

(Boston Globe April 5, 2005)

- Revlon, Unilever and L’Oreal already comply with EU
- FDA only regulates sunscreen and anti-dandruff shampoos
- Sodium borate in diaper rash creams should not be used on infant skin
- Recent study of ingredients include over 7,500 compounds
- 1 in 120 cosmetic items has suspected chemical health hazards
- Historically dark hair dyes increased risk of non-hodgkins lymphoma
**CDC’s Body Burden Study**

- Organophosphate metabolism in everyone
- Short half life
- Suggest wide scale general use

From: National Report on Human Exposures to Environmental Chemicals, CDC, 3/21/01

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**Public Housing Residents use of pesticides: 93% in NYC, 83% in Boston**

---

**Toxicities of Target Pesticides**

<table>
<thead>
<tr>
<th>Target Pesticides</th>
<th>Oral LD₅₀ in Rat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorpyrifos</td>
<td>45-163</td>
</tr>
<tr>
<td>Diazinon</td>
<td>100-400</td>
</tr>
<tr>
<td>Cypermethrin</td>
<td>50</td>
</tr>
<tr>
<td>Fenmethrin</td>
<td>93</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>409</td>
</tr>
<tr>
<td>Lambda-Cyhalothrin</td>
<td>45</td>
</tr>
<tr>
<td>Deltamethrin</td>
<td>45</td>
</tr>
<tr>
<td>Esfenvalerate</td>
<td>45</td>
</tr>
<tr>
<td>Cyhalothrin</td>
<td>64</td>
</tr>
<tr>
<td>Aldrin</td>
<td>100</td>
</tr>
<tr>
<td>Oxamethrin</td>
<td>2300</td>
</tr>
<tr>
<td>Sumithrin</td>
<td>3500</td>
</tr>
<tr>
<td>Terbutrin</td>
<td>5000</td>
</tr>
</tbody>
</table>

Toxicities of certain pyrethroids are comparable to chlorpyrifos and diazinon

---

**Prevalence and Concentrations for a Subset of Pesticides in Floor Wipes (µg/m²)**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Median</th>
<th>Max</th>
<th>n detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deltamethrin</td>
<td>124.5</td>
<td>&lt;LOD</td>
<td>10</td>
</tr>
<tr>
<td>Cyhalothrin</td>
<td>257.5</td>
<td>&lt;LOD</td>
<td>7</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>615.6</td>
<td>66.4</td>
<td>60</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>945.5</td>
<td>55.6</td>
<td>93</td>
</tr>
<tr>
<td>Diazinon</td>
<td>962.7</td>
<td>0.7</td>
<td>91</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>992.3</td>
<td>26.3</td>
<td>99</td>
</tr>
</tbody>
</table>

Banned by EPA
- Tempo product restricted to pesticide applicators
- Chalk form not allowed in the US

---

**Development-Wide: Frequency of Pesticides Detected in Homes (N=39) using Floor Wipes**
Pesticide Levels in 48-h Personal Air Samples during Pregnancy & in Blood Samples at Delivery from Urban Minority Mothers and Newborns

- Whyatt et al.* recruited nonsmoking African American & Dominican Women, 18-35 years old
- During 3rd trimester of pregnancy, personal air samples were obtain and a questionnaire about pesticide use was administered.
- At delivery umbilical cord blood was obtained, and after maternal postpartum blood.


Whyatt et al. (2002) continued

- 85% of women reported using pest control during pregnancy
- 35% reported using pest control services
- Organophosphates, diazinon and chlorpyrifos were detected in 100% of air samples and 54%-97% of bloods samples. Carbamates were also detected in 100% of air samples and 68% of blood samples
- OP in newborn blood associated with lower birth weights, shorter lengths and smaller heads

Northern California Childhood Leukemia Study (Bufler & Smith, U Cal Berkeley School of Public Health)

AML 1 protein → Regulates gene activity for blood cell development from stem cells

AML-ETO translocation

Second gene mutation to Trigger Acute Myeloid Leukemia (AML)

AML

Prenatal Exposure

“Heel Prick” Blood Sample of Newborns

Diagnostic Blood Samples confirm AML 1-ETO, MLL-AML 1, TEL-AML 1 Translocations

Northern California Childhood Leukemia Study (continued)

- 162 children with leukemia matched with 162 controls
- Residential pesticide use: product, purpose & frequency for 3 months prior to pregnancy through 3 years
- Parental occupational exposure
- Findings: Pesticide exposure during pregnancy rather than later in life had the highest observed risk.
- Significant association between the use of professional pest control services and increased risk.


Last Sanctuary?
World Population

- 2/3 in Developing World
- 1/2 Billion in Poverty
- 1-2 Billion
  - inadequate access to clean water
  - poor sanitary conditions

“Children in the new millennium: Environmental impact on health”
UNICEF, UNEP, and WHO report 2002

- 10% of world population under < 5 yrs.
- Bear 40% of the burden of environmental disease
- 5,500 children die daily from poor water
- Millions sick and die from air pollution

Cooking with Biomass and Charcoal Fuels

Kirk Smith reported conservative estimates of
2 – 3% of global DALY

IA2002 WHO Global Burden of Disease Project
**Contact Information:**

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Akira Yamaguchi Professor of Health & Human Habitation
Harvard School of Public Health
Department of Environmental Health
Landmark Center
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401 Park Drive, Room 406
Boston, Massachusetts 02215

Telephone: 617-384-8810
FAX: 617-384-8819
email: jack_spengler@harvard.edu

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**INDOOR AIR QUALITY**

2006

John D. Spengler, Ph.D.
Akira Yamaguchi Professor of Health & Human Habitation
Harvard School of Public Health

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**The Air We Breathe**

- Air as a Public Good
- It Cost Nothing to Use
- Quality Not Diminished by the Number of Users
- Contaminants Interfere with Health, Comfort, Productivity and Enjoyment
- If Quality is Diminished then it is the Obligation of Government to Protect the Public Good

**IAQ and Building Costs**

- Labor $200 / square foot
- Financing $ 20 / square foot
- Energy $ 2 / square foot
- Cleaning $ 1 / square foot

---

**The Costs of People Overshadow Building Costs**


**Health Care Costs Are Substantial**

![Graph showing health care costs. Employee Compensation, Total Health Expenditure, Private Sector Health Insurance, Commercial Building Energy. *U.S. Data from 1995 or 1996.*]
**Health Gains from Better IAQ**

- Reduce Respiratory Disease $6-14 Billion
  - 176 Million Sick Days
  - 121 Million Restricted Activities
  - Medical Care Costs $36 Million
  - Lost Work Costs $34 Million

- Reduced Allergies and Asthma $2-4 Billion
  - 20% of US Population have Allergies
  - 6% of US Population have Asthma

Source: Fisk and Rosenfeld, 1997 Indoor Air 7:158-172

---

**Productivity Gains from Better IAQ**

- Sick Building Syndrome $10-30 Billion
  - 50% of Work Force in Offices/Schools
  - 23% Complain of Sick Building Syndrome
  - 2% Productivity Gains

- Improved Lighting & Thermal $20-160 Billion
  - 0.5 - 5% Performance Gains

Source: Fisk and Rosenfeld, 1997 Indoor Air 7:158-172

---

**How Sustainable Buildings Could Improve Health & Productivity**

- Green/Sustainable Buildings
- Better design, construction, commissioning & O&M
- Improved Indoor Environmental Quality
- Superior Work Performance
- Less Absence
- Reduced Health Care Costs
- Economic Benefits

- Better Health
- Thermal state
  - Hearing and concentration
  - Vision
  - Mood
  - Mental performance

---

**How IAQ Problems Present**

- Boston Globe
- April 13, 1995

---

**IAQ Problems**

Conditions of Discomfort, Irritation, Illness, or Sense of feeling unhealthy that Occupant(s) Associate with Building

---

**Sick Building Syndrome**

- Symptoms Linked to Building
- Resolve When Not in Building
- Effect a Substantial Fraction of Occupants
Sick Building Symptoms

- Dry - Itchy Eyes
- Nasal Irritation
- Hoarseness, Irritated Throat, Laryngitis
- Skin Problems
- Fuzzy Thinking, Memory
- Irritability, Sleep Disruption, Fatigue
- Headaches, Nausea

Building-Related Illness

- Definite Condition Caused by Physical Biological, Chemical Agent in Building

Building-Related Illness

- Discrete, identifiable disease or illness
- Can be traced to specific pollutant or source within a building
- Examples: Legionnaires’ disease, hypersensitivity pneumonitis, humidifier fever, carbon monoxide poisoning

Infections

- Contagious diseases
  - Influenza
  - Chicken pox
  - Measles
  - Common cold
  - Tuberculosis
- Environmental-source infections
  - Legionnaires’ disease
  - Pontiac fever
  - Histoplasmosis

Associations May be Triggered by:

- Odors
- Drafts
- Temperature
- Humidity
- Dust
- Rumors
- Vibrations
- Visual Changes

- New Equipment
- Alterations
- Maintenance
- Inspection Services
- Management Stresses
- Labor Issues
- Personal Agendas

Boston
Maintenance?

Mixing Chamber

Condensate Drip Pan

Scalling from Drip Pan

Slime Mold Morphogen

Dirty Cooling Coils
Cleaning Coils

Clean Coils

Ventilation Ducts

Fiberglass Soundproofing

Rodent Nest

Fiberglass Lined Ducts
Testing Mixing

Ventilation Requirements
- 1.5 cfm/person – O₂ demand
- 2.5 cfm/person – CO₂ dilution
- 5 cfm/person – old energy standard
- 10 cfm/person – people without sources

Ventilation

Fresh Outside Air – delivered indoors
- cfm/person
- cubic feet per minute per person
- or –
- l/s – p
  liters per second per person

Minimum Ventilation Rates

Ventilation Guidelines
- Minimum
  – 15 cfm/person
- Office
  – 20 cfm/person
- Smoking
  – 60 cfm/person

Schools
**Fire Stations**

**Swimming Pool**

**Ice Resurfacer**

**Our Buildings, our Homes and our Schools**

Link health and productivity of indoor environments to sustainability

We need factors of 10 not factors of 2 improvements

**The Right to Healthy Indoor Air**

- **Rights to health** – breathing clean indoor air
- **Rights to information** – indoor exposures
- **Principle of non-maleficence** – do no harm
- **Principle of beneficence** – responsibility of individuals, organizations and governments to bear responsibilities for good indoor air
- **Principle of social justice** – the SES of occupants should not determine quality of air
The Right to Healthy Indoor Air

- **Principle of accountability** – should establish explicit criteria for indoor air
- **Precautionary principle** – uncertainty shall not postpone prevention
- **Polluter pays principle** – manufacture, managers, individuals responsible for mitigation
- **Principle of sustainability** – must consider global and ecological integrity

[http://www.who.dk/cpa/Backgrounders_2000/pb0004e.htm](http://www.who.dk/cpa/Backgrounders_2000/pb0004e.htm)

Thank you for your attention

What is this Swedish study indicating

A large part of the population is exposed for phthalates

**BBzP** and **DEHP** in dust are associated with the amount of PVC used as floor and wall materials

**BBzP** associated with self reported water leakage

**DEHP** associated with buildings constructed before 1960

Many other sources!

What is this Swedish study indicating

Phthalates in dust are strongly associated with symptoms
- **BBzP** associated with rhinitis and eczema
- **DEHP** associated with asthma
- **DnBP** not associated with symptoms
  - No association to sensitization
  - Mechanisms not known (adjuvance, irritation…?)